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Internship in Plasma Physics
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Summer 2004

During my tenure with Prof. S. Suckewer's research group, I have spent the majority of my time working on a project exploring plasma generation of high aspect ratio with a picosecond pulse. The experiment involves developing a method for the creation of such a plasma, and in addition to performing diagnostics on the plasma. During this past summer, working as an intern for the PPPL, I worked with Y. Avitzour and Dr. Duneavsky to add several features to the experimental setup. Of these features the primary items were

Implemented a new plasma cell, fashioned by Dr. Duneavsky

An intereferometry setup for the diagnostic laser

Setup for axial plasma generation for the ionization beam

Other minor features added were:

Implemented 2nd harmonic generation for the diagnostic beam

Added an output monitoring system for the ionization beam

Adapted a new CCD system to work with the experiment

The new plasma cell replaces the plexiglas cell I began constructing at the end of my internship last summer. In addition to being able to withstand greater pressure gradients, due to sturdy aluminum construction, the new cell utilizes pinhole openings 100 microns in diameter, half the size I was able to create for my chamber.

Prior to this summer our diagnostic laser pass merely crossed the path of the ionization beam. Without a reference pass and a separate probe pass, our diagnostic laser

was limited to creating a silhouette of the plasma generated in the plasma cell. With our new intereferometry setup we can now measure the density of free electrons in the plasma relative to the ambient gas in the cell. In addition this method is far more sensitive allowing significantly lower density plasma to be detected than the silhouette method.

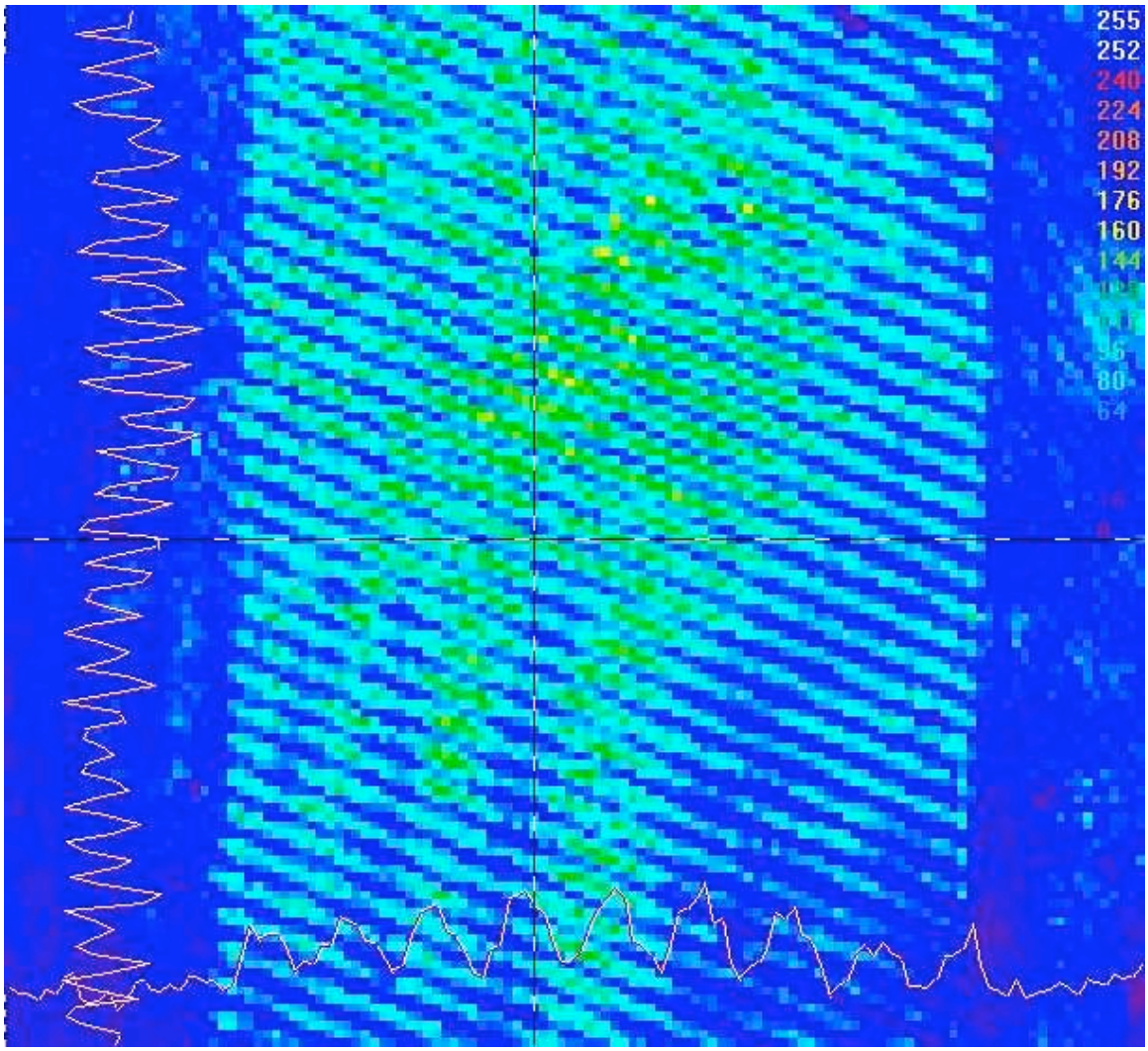
In response to problems the project ran into while attempting to generate plasma transversely, we reworked our experimental setup to generate plasma along the axis of the ionization beam. This summer we further refined this setup to utilize two cylindrical lenses in place of a spherical lens. This pair of lenses is able to take advantage of the rectangular beam profile of the ionization beam, and allows a smaller beam diameter at the focus of the lenses. The disadvantage of this setup is that the focal points of the two lenses must coincide, and as a result the system must be more carefully aligned.

In addition to the major changes to the experimental setup, we altered a few minor features. First we switched our diagnostic beam to output its 2^{nd} harmonic. This was done to avoid having a situation in which the ionization beam interferes with our images obtained fom the diagnostic beam. Prior to the switch the two beams lased on the same frequency prventing us from being able to filter out scattered light from the ionization beam. After switching the diagnostic laser to its 2^{nd} harmonic we also began constructing a system to montior the energy output of the ionization laser. The picosecond laser we use as our ionization beam has a somewhat unstable energy output, and due to this it is advantageous to be able to pair ionization behaviors with laser output. The last item I worked on before leaving the project was a new CCD system. Working with Dr.

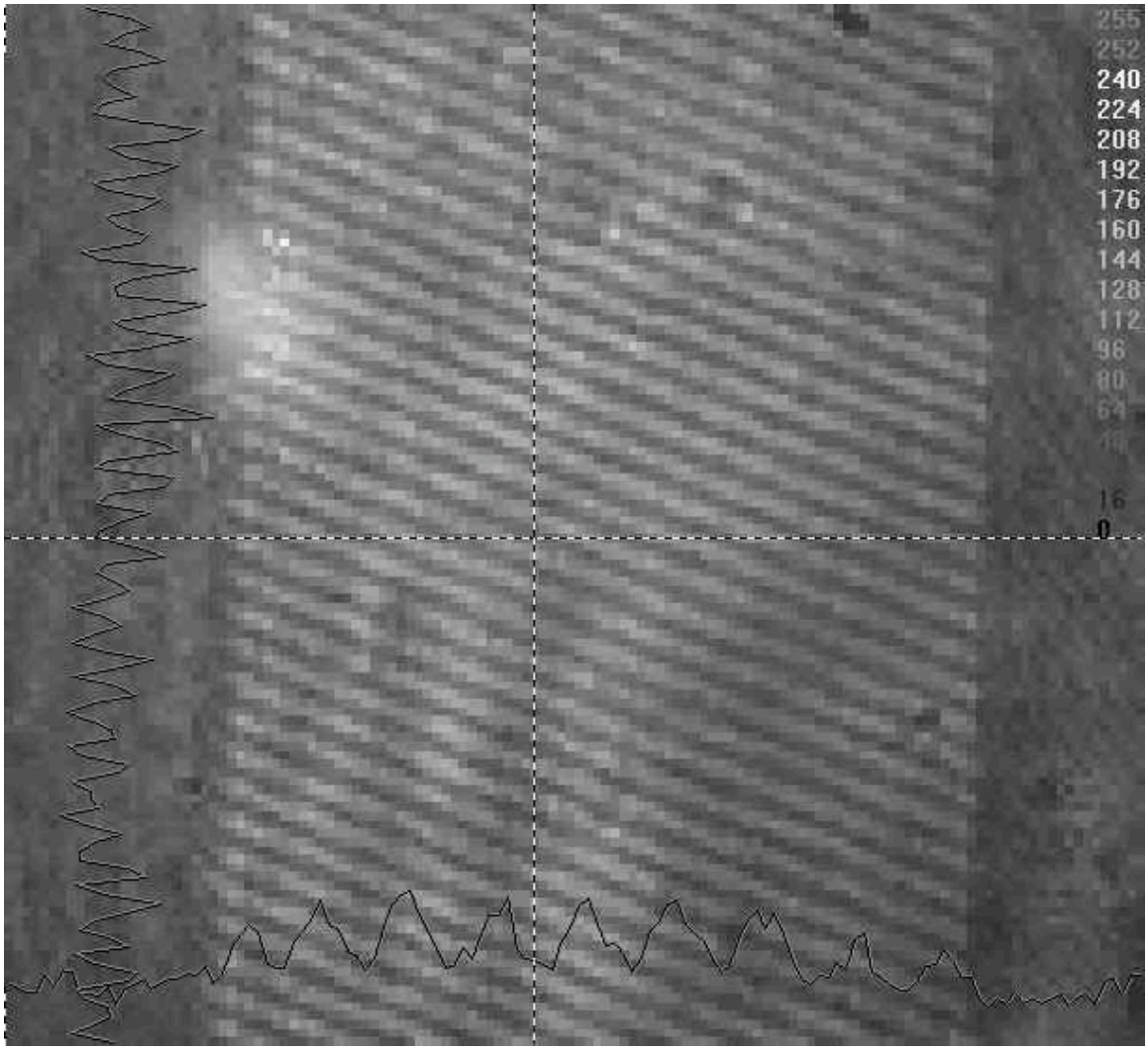
Duneavsky we syncronized a CCD to our timing system allowing it to capture images out of the ultrafast laser pulses used in the experiment.

Results

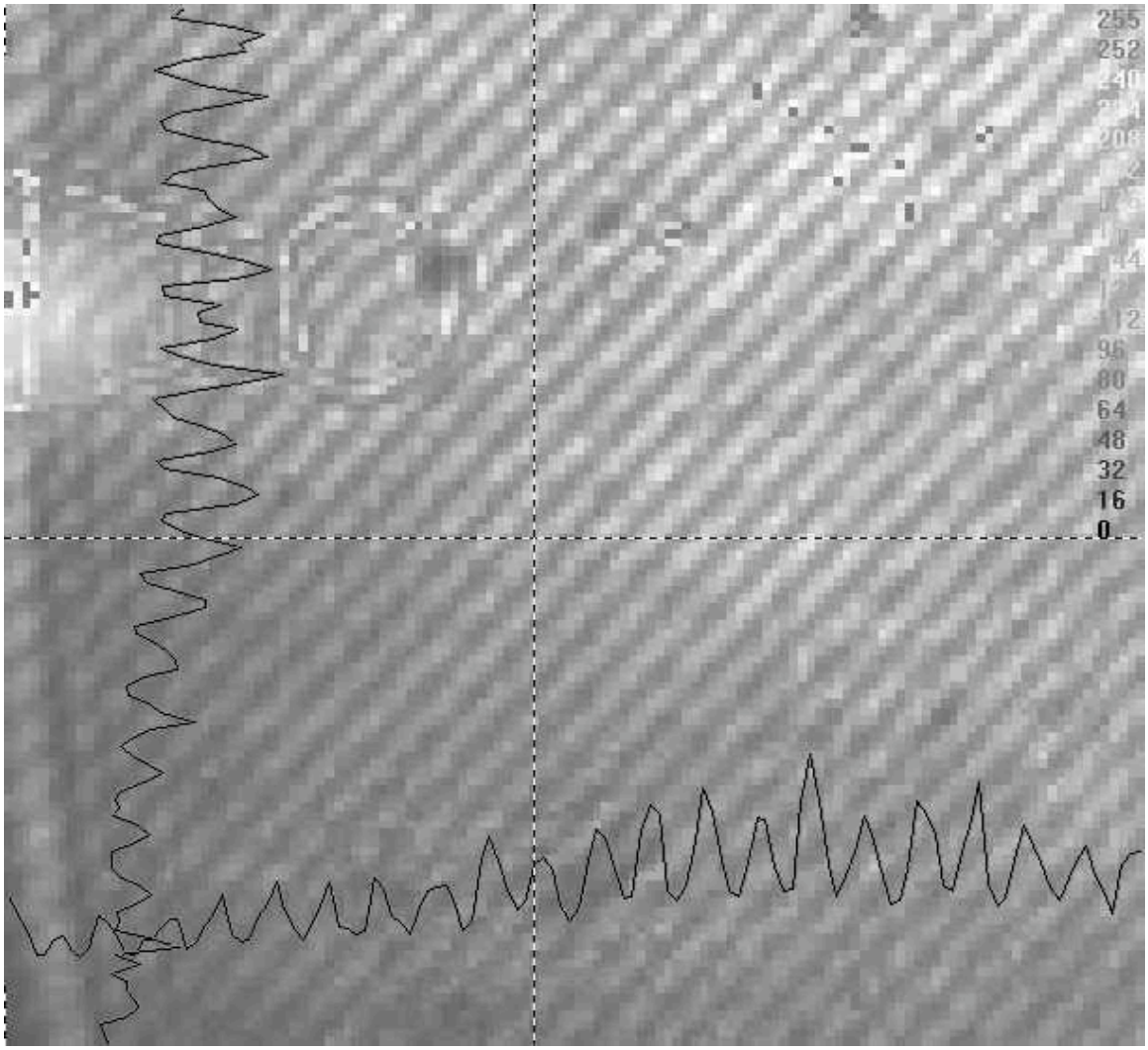
During the summer we did have the chance to make a few intereferograms of the ionization in the plasma cell. However, the density of the plasma in the cell was not great enough to create a noticable shift in the fringes of the intereferograms.



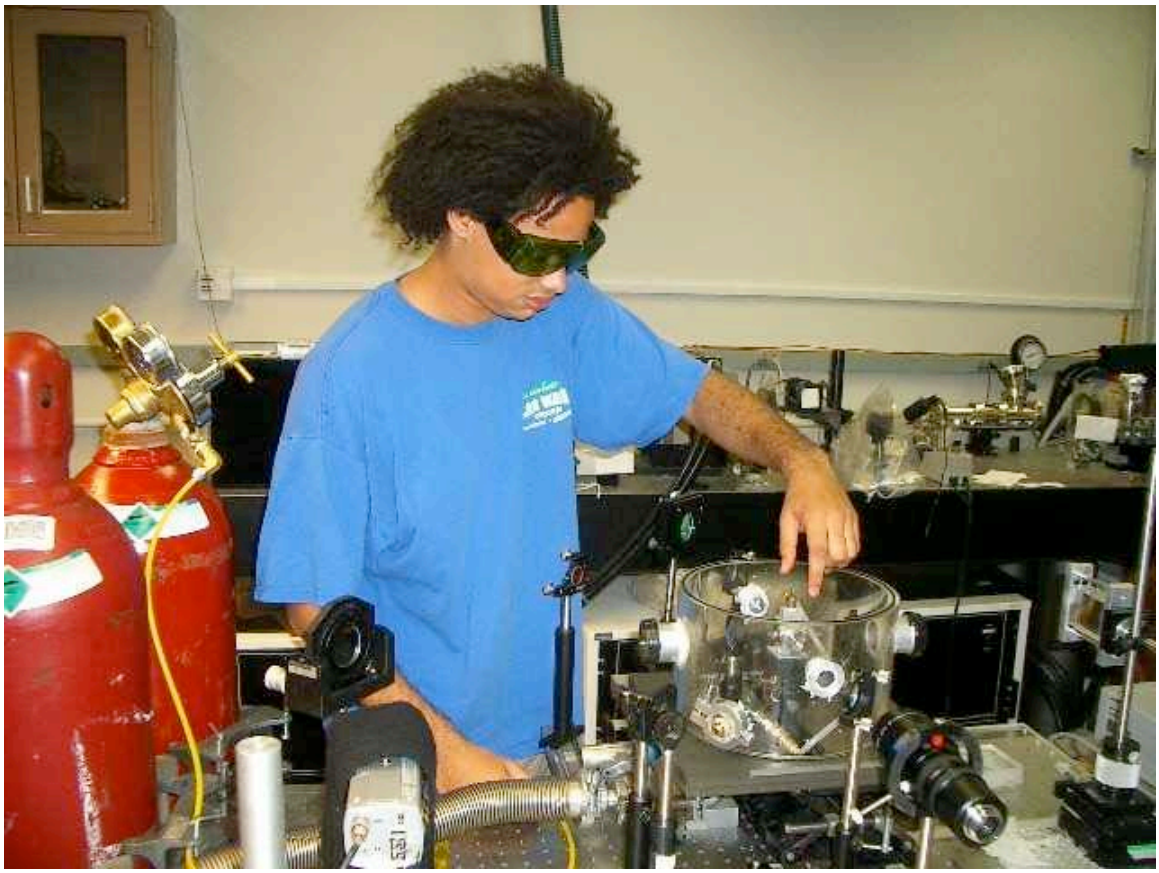
An inteterferogram of the inside of the plasma cell. The sharp cutoff of the fringes on the sides of the image are the walls of the plasma cell.



Scattered light from the ionization present on the cell wall.



An intereferogram of plasma created with no cell or vacuum present. On the left side of the image one can see the shift created from the shockwave generated by the expanding plasma.



A picture of me while working with the plasma cell and vacuum chamber.